



Reclamation Research Unit

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Date: October 26, 2004

To: Sue Sillick

From: Stuart Jennings

Re: Progress Report 5. *Evaluation of Organic Matter Addition and Incorporation on Steep Cut slopes, Phase II: Test Plot Construction and Performance Monitoring*

The fifth progress report of Phase II of the above referenced project is attached. The attached narrative describes monitoring of vegetation and erosion at both the Happys Inn and Miles City research sites. The first year of monitoring has been completed. The data tables are attached to this progress report for your consideration.

Quarterly Progress Report #5
For the period July 1, 2004 – September 30, 2004

**EVALUATION OF ORGANIC MATTER ADDITION
AND INCORPORATION ON STEEP CUT SLOPES**

***Phase II: Test Plot Construction and
Performance Monitoring***

Prepared For:

Montana Department of Transportation
P.O. Box 201001
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Prepared By:

Reclamation Research Unit
Department of Land Resources and Environmental Sciences
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October 2004

Task Analysis and Discussion

No activity occurred during the quarter on the project tasks: A, B, C, D, E, F, G, H, I, K and L. As of the end of this quarter Tasks A, B, C, D, E, F, G and H are 100% complete. Two principal activities occurred during the past quarter: Year 1 monitoring (Task J) and reporting (Task M). Year 1 monitoring is now 100% complete while reporting is estimated to be 35% complete.

Task J - Year 1 Monitoring

Monitoring of research sites on U.S Highway 2 near Happy's Inn occurred on September 13 and 14, 2004. Monitoring of the Happy's Inn research sites for the spring event occurred during the second quarter of 2004. Since the Miles City test plots were only constructed during the second quarter of 2004, the spring monitoring event was pushed into early July to allow time for seedling germination. As a consequence, both the spring and fall monitoring events for the Miles City test plots occurred during the third quarter. Monitoring occurred at the Miles City site on July 7-8 and September 27-28, 2004. These data are appended to this progress report.

As a general observation, the plants established at the Miles City research site are small, typically less than 4 inches tall. Several grass stems per square foot are generally observed on the treated plots. It appears that germination occurred twice during the 2004 growing season; initially in July and again in September subject to availability of moisture. Drought conditions have been a significant issue in Miles City. Erosional features have begun to be observed on nearly all of the test plots such as imprinting of the soil surface by storm water flow patterns, movement of soil, litter and pebbles as well as the development of rills. The density of seeded species is acceptable for first year reclamation, yet more time is required to determine if these plants are able to grow to maturity.

Research plots in Northwest Montana near Happys Inn show outstanding first year vegetation condition. Above average summer rainfall and success of the compost treatment resulted in dense vegetation development. Many of the species seeded grew to maturity and produced seedheads. The control plots with no compost addition revealed comparatively sparse vegetation development. Several images are included in this progress report. The control plot at the Milepost 77 site is outside the camera view, but similar to the untreated areas between the compost plots.

Task K - Year 2 Monitoring

This task has not been initiated.

Task L - Year 3 Monitoring

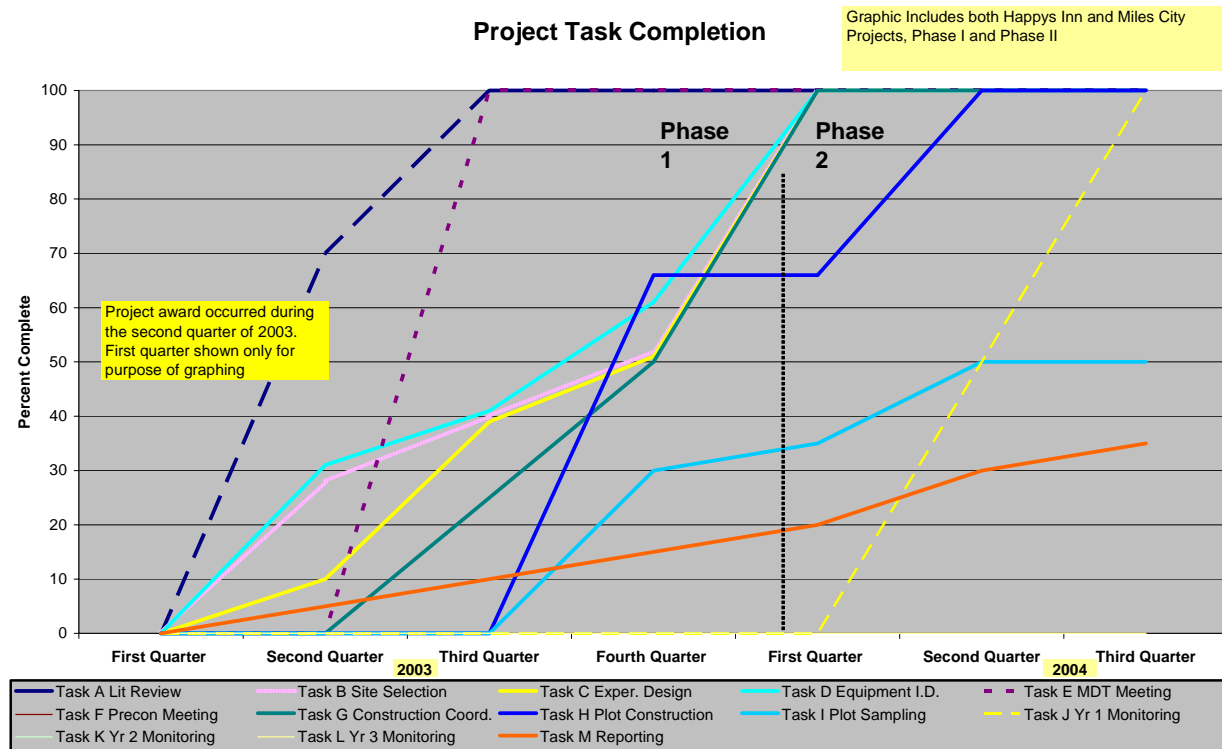
This task has not been initiated.

Task M - Reporting

This fifth quarterly report satisfies the periodic reporting requirement of the contract. A Final Report will also be completed in 2006 summarizing the research findings. This report includes data from monitoring occurring during the third quarter 2004. These data will ultimately be compiled in the final report late in 2006.

Schedule and Degree of Completion—all research sites

<i>Task Description</i>	<i>Budgeted Total Phase II</i>	<i>Proposed Schedule</i>	<i>Actual Schedule</i>	<i>Degree of Completion</i>	<i>Estimated Expenditure during current quarter</i>
Task B Site Reconnaissance	\$678	Q3, 2003	Q3 2003, and Q1 2004	100%	0
Task C Experimental Design	\$407	Q4, 2003	Q4 2003, and Q1 2004	100%	0
Task G Construction Schedule Coordination	\$377	Q3, 2003	Q1, 2004	100%	0
Task H Plot Construction	\$36,087	Q4, 2003	Q4, 2003	100%	0
Task I Site Sampling	\$8761	Q4, 2003 and Q3 2005	Q4, 2003; Analytical results Q1, Q2 2004	50%	0
Task J Year 1 Monitoring	\$13,083	Spring and Fall, 2004	NA	100%	\$8,000
Task K Year 2 Monitoring	\$15,912	Spring and Fall, 2005	NA	0%	0
Task L Year 3 Monitoring	\$16,065	Spring and Fall, 2006	NA	0%	0
Task M Reporting	\$16,380	Quarterly and Final Report, Fall 2006	ongoing	35%	\$1,117



Review of the proposal for this project anticipated that all of the tasks (A-J) would be completed by the end of the federal fiscal year on September 30, 2004 with the exception of Task I, Site Sampling, which was expected to be 50% completed. Reporting (Task M) is on-going. The completed project work, therefore, very closely approximates the schedule and budget. The predicted project expenditure at the end of the federal fiscal year was \$65,558 the actual project expenditure was approximately \$64,303. Incurred expenses are approximately 1.9% behind the budgeted amount while work accomplished to date is ahead of task. Additional work was accomplished during construction where 5 additional plots were built at the Miles City site. This work was not anticipated in the original cost proposal. Substantial progress has also been made in preparation of the final report due in the 4th quarter of 2006 by completing write-ups as work has been completed. Cost savings have also been accrued by scheduling monitoring work at MDT project sites in coordination with unrelated research occurring in the same geographic area to allow for splitting of labor and travel expenses between projects. Overall, the scope, schedule and budget appear to be in good alignment with slightly more work being completed during the first year than expected using slightly less money than budgeted.

Problems and Resolution

No problems were observed at the Happys Inn research sites on U.S. Highway 2.

The Miles City research plots have been plagued by drought during the first growing season. As a result, comparatively few plants germinated and established during the growing season. During September monitoring many plants were observed germinating in response to late summer rain. The density of plants observed was encouraging. Apparently many of the seeds survived summer drought conditions germinating only in response to adequate rainfall. High intensity rainfall was a problem on the plots established along U.S. 12. Since the plots were not constructed the full length of the slope stormwater runoff originating above the plots has been substantial. The silt fence installed during plot construction was blown out and a significant gully cut through one of the experimental plots. Vegetation monitoring transects have been established in areas unaffected by the gully. Repairs to the silt fence and construction of an additional stormwater diversion ditch have been performed.

Accomplishments

- First Year monitoring at Miles City and Happys Inn was completed. Two monitoring trips were completed to Miles City, the first in early July and the second in late September. Two monitoring trips were also completed to Happys Inn, the first occurring during the second quarter of 2004 while the second trip occurred in September.
- Vegetation development at the Happys Inn research site has been remarkable. Vegetation grew to maturity on all of the compost treated plots while the control plots exhibited very sparse vegetation development. Statistical tests have not been applied to demonstrate statistically significant differences between treatments at this time, but the compost plots exhibit undeniably robust vegetation development that will only be confirmed by statistical testing. All of the compost plots exhibit outstanding plant growth when compared to the adjacent area disturbed during reconstruction of the roadway several years ago (images below).



Figure 1. Vegetation development at the end of the first growing season, lacustrine silt parent material.

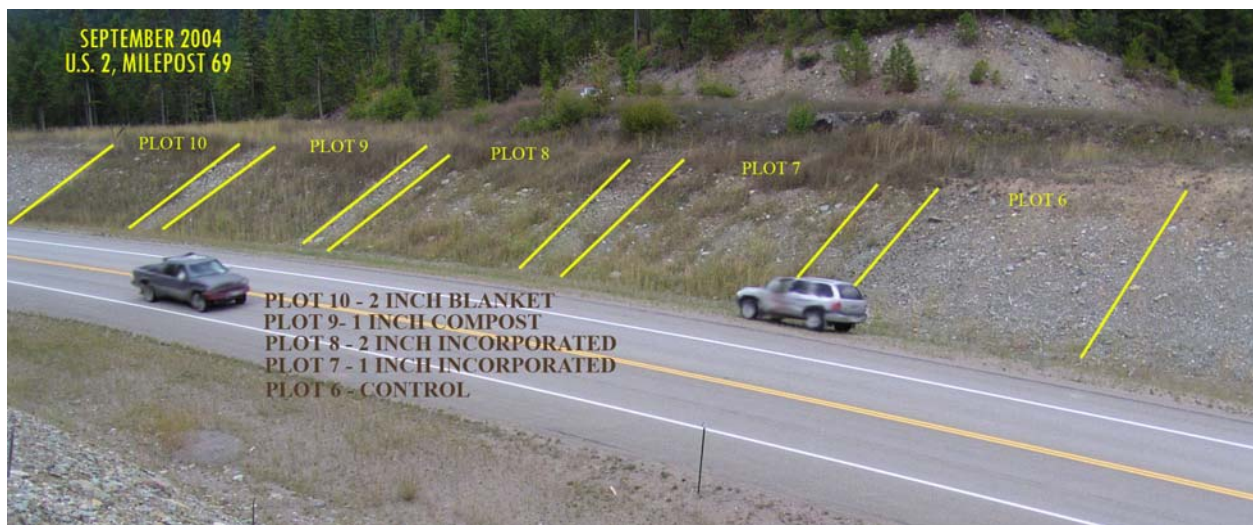


Figure 2. Vegetation development at the end of the first growing season, alluvial rock parent material.

Fiscal Expenditure

Amount Spent by budget category:

<i>Cost Category</i>	<i>Spent prior to current quarter (\$) [revised]</i>	<i>Spent during the current quarter (\$)</i>	<i>Total spent to date (\$)</i>
Labor and Benefits	\$25,396	\$6927	\$32,323
Operational Expenses	\$4098	\$1145	\$5243
Subcontracted Services	\$16,764	0	\$16,764
Indirect Charges	\$8928	\$1045	\$9973
<i>Total Spent</i>	<i>\$55,186</i>	<i>\$9,117</i>	<i>\$64,303</i>

Total Project Award \$108,975

Amount Remaining \$44,672

**Progress Report
Attachments**

Table B3. Vegetation Monitoring, U.S. Highway 2, Milepost 76, Middle Thompson Lake (plots 1-5) and Milepost 69, Loon Lake (plots 6-10), September 2004. The Middle Thompson Lake plots are constructed on glacial silt while the Loon Lake plots are constructed on alluvial rock.

Plot Number	Frame Number	Tape Distance (feet)	Plant stems/ Frame (20x50 cm)	Aerial Cover (%)				Comments
				Grass	Forbs	Rock	Mulch	
1	1	14	9	1				all very small grass plants
	2	16	16	1				all very small grass plants
	3	18	14	1				all very small grass plants
	4	25	16	1				all very small grass plants
	5	33	13	1				all very small grass plants
	6	42	9	1				1 forb
	7	45	7	1				
	8	53	5	1				all grass
	9	55	4	<1	12			1 "large" Black medic; 3 grass
	10	56	2	<1				
2	1	18	10	65				much seed visible
	2	25	14	40				
	3	26	20	40				
	4	35	10	47.5				photo taken
	5	36	9	30			3	
	6	42	11	32.5			<1	
	7	47	13	65			1	
	8	53	18	37.5	5		<1	knapweed; very small kochia
	9	60	11	32.5			1	
	10	66	7	25			15	
3	1	6						All plots approx. 10 bunch plants
	2	15	>10	85			1	
	3	20	>20	100			1	
	4	28	>20	95			1	
	5	33	>15	85			2	
	6	35	>20	85			2	
	7	36	>20	90			2	
	8	42	>6	60	7		3	forbs; 95% is Black medic
	9	47	7	9	35		7	forbs; sweetclover dominates
	10	53						forbs: flax, meof, cema (7% of 35%)
4	1	14	13	20	35		1	
	2	14	>11	95	<1		5	
	3	17	>20	98			2	
	4	21	>13	99			1	
	5	23	>12	100				
	6	28	>7	98			2	
	7	36	>3	90			10	
	8	44	>11	95			5	
	9	45	>12	95			5	
	10	54	>12	90			2	
5	1	60	>9	95			5	
	1	7	>6	100				
	2	13	>8	82			12	
	3	17	>7	87			13	

Plot Number	Frame Number	Tape Distance (feet)	Plant stems/ Frame (20x50 cm)	Aerial Cover (%)				Comments
				Grass	Forbs	Rock	Mulch	
5 (cont.)	4	18	>5	85			15	
	5	23	>1	29			71	many seeds; photo taken
	6	32	>12	100			13	
	7	39	>5	84			35	
	8	42	>5	58			68	edge effect?
	9	50	>2	29			93	edge effect?
	10	60	1	7				
6	1	5	4	2	<1	97		2 forbs
	2	12	4	1		97		
	3	16	1	<1		97		
	4	23	4	1		96		
	5	31						
			7	2	12	80		large ce ma rosette, 1 mustard
	6	35	4	<1	7	85		ce ma rosette
	7	43	8	3	<1	90		
	8	46	22	12	1	40		ce ma - 1 plant
	9	52	13	13	1	65		ce ma
	10	56	5	<1	7	45		ce ma - most of forb cover
7	1	13	23	20		75		
	2	15	16	30		68		
	3	19	9	17		75		
	4	21	22	35		55	5	
	5	29	16	28		63	5	dead plant in frame
	6	32	17	50		45	4	
	7	38	10	28	1	60		ce ma
	8	40	10	17	<1	70		
	9	42	14	7	5	75	2	ce ma
	10	50	19	25	25	5	10	ce ma
8	1	12	>10	45		48	2	
	2	20	11	28		65	1	
	3	24	14	28		65	3	
	4	30	16	10	5	75	1	white sweetclover
	5	34						
			17	15	4	70	1	several small festuca; 2% each me al, ce ma
	6	41	>15	65	5	7	15	
	7	45	13	40	6	7	15	
	8	52	53	35	17	7	8	39 ce ma plants, 14 grasses
	9	55	27	55	15	3	4	18 ce ma plants
	10	56	54	30	8	3	5	34 ce ma plants
9	1	11	18	35	50	10	5	Alfalfa
	2	15	28	50	2	17	10	18 ce ma
	3	20	15	22		10	50	
	4	28	13	20	<1	13	50	
	5	33	13	25		12	20	
	6	40	14	33	1	5	20	7 ce ma
	7	42	23	25	1	20	10	12 ce ma; photo taken
	8	48	>48	30	30	15	2	36 ce ma; all of forb cover
	9	52	68	25	35	5	15	56 ce ma
	10	54	111	35	30	3	15	93 ce ma
10	1	5	5	25		7	50	
	2	8	9	28		8	15	

Plot Number	Frame Number	Tape Distance (feet)	Plant stems/ Frame (20x50 cm)	Aerial Cover (%)				Comments
				Grass	Forbs	Rock	Mulch	
10 (cont.)	3	17	9	55		2	35	
	4	20	2	3		5	75	
	5	24	0	5		3	45	
	6	30	9	25		45	3	
	7	33	7	15	50	8	15	1 large ce ma
	8	45	7	30	2	5	30	12 ce ma
	9	52	24	22	20	10	15	16 ce ma (sm); 2 lg ce ma
	10	59	47	25	55		5	37 ce ma (sm); 1 lg ce ma

Table B4. Erosion evaluation of U.S Highway 2 plots, September, 2004.

Plot Number	Erosion score *	Erosion Ranking**	Comments
1	64	Critical	Surface litter not used in score
2	48	Moderate	
3	37	Slight	
4	10	Stable	
5	10	Stable	Edge effect at top of plot (top of road cut)
6	33	Slight	Surface litter not used in score
7	23	Slight	
8	11	Stable	
9	30	Slight	
10	25	Slight	

* Erosion score is determined based on 100 point system developed by Clark (1980)- Erosion Condition Classification System, U.S. Dept. of Interior, BLM Technical Note 346.

**Stable=1-20 points, Slight=21-40 points, Moderate=41-60 points, Critical=61-80 points, Severe=81-100 points.

Table B5. Vegetation Monitoring, Miles City, U.S. 12 test plots (11-15) and I-94 test plots (16-20), September 2004.

Plot #	Frame #	Tape Distance (feet)	Plant stems/ Frame (20x50 cm)	Aerial ----- Cover -----				Comments
				% grass	% forbs	% rock	% Litter	
11	1	11	7	<5	30	<2	5	Salsola kali
	2	12	9	<1	60	<1	5	Salsola kali
	3	15	1	<1	2	<1	8	
	4	23	0	0	0	2	0	
	5	25	5	5	0	<1	10	Grass grazed (deer?)
	6	35	2	<5	<1	<1	10	
	7	41	1	<1	0	3	5	
	8	46	0	0	3	1	5	
	9	56	0	0	4	<1	10	
	10	59	0	0	<1	2	5	
12	1	7	7	0	55	<1	10	Salsola kali mostly
	2	13	6	<5	0	<1	15	
	3	17	0	0	7	<1	10	
	4	18	2	<1	3	<1	5	
	5	24	1	<1	3	<1	15	
	6	25	9	7	3	<1	10	All grass
	7	28	0	0	0	<1	10	
	8	35	6	1	7	<1	10	2 forbs, 4 grasses
	9	43	3	<1	5	<1	10	1 grass
	10	45	4	<1	30	<1	5	Salsola kali
13	1	9	7	3	80	<1	16	4 grass, 3 forbs, mostly salsola kali
	2	11	3	2	60	<1	15	2 grass, 1 forb
	3	13	3	1	30	<1	20	1 grass, 2 forbs
	4	14	1	0	5	1	25	Salsola kali
	5	23	7	7	50	<1	10	
	6	30	2	<1	3	2	15	1 forb, 1 grass
	7	34	6	5	7	<1	15	
	8	39	2	2	40	2	10	
	9	49	2	<1	7	1	15	1 grass, 1 forb
	10	55	3	<1	10	<1	10	1 grass, 2 forbs
14	1	5	110	7	3	<1	<5	91 grass, 19 forbs
	2	12	47	3	40	<1	<1	Mostly grass plants – 20 forbs
	3	13	20	1	5	2	2	17 grass, 3 forbs
	4	23	7	<1	3	<1	2	1 grass, 6 forbs
	5	27	4	2	0	1	5	4 grass
	6	34	32	2	40	<1	5	7 forbs, 25 grass
	7	35	14	1	15	<1	7	11 grass, 3 forbs
	8	43	5	1	7	1	3	4 grass, 1 forb
	9	49	10	<1	15	1	<1	1 grass
	10	56	17	<1	10	2	5	1 grass
15	1	2	6	<1	5	<1	7	3 grass, 3 forbs
	2	9	7	3	<1	2	15	6 grass, 1 forb
	3	14	5	3	3	2	25	5 grass
	4	23	7	3	3	1	25	6 grass, 1 forb
	5	33	42	7	80	<1	12	Salsola kali (6), 36 grass
	6	36	5	2	40	<1	35	4 grass, 1 forb

Plot #	Frame #	Tape Distance (feet)	Plant stems/ Frame (20x50 cm)	Aerial ----- Cover -----				Comments
				% grass	% forbs	% rock	% Litter	
15 (cont.)	7	37	4	2	40	2	40	4 grass
	8	45	3	2	0	3	40	3 grass
	9	54	3	2	10	3	10	2 grass, 1 forb
	10	58	1	<1	3	3	20	1 grass
16a	1	7	10	<1	5	<1	40	9 grass, 1 forb – many new seedlings
	2	8	24	1	45	<1	30	19 grass, 5 forbs
	3	12	26	1	60	<1	20	17 grass, 9 forbs
	4	20	12	2	75	<1	20	10 grass, 2 forbs (Kochia)
	5	23	5	5	35	<1	40	3 grass, 2 forbs
	6	30	7	<1	25	<1	35	2 grass, 5 forbs
	7	35	4	<1	25	1	25	2 grass, 2 forbs
	8	38	10	<1	35	<1	35	8 grass, 2 forbs
	9	40	7	<1	90	<1	1	5 grass, 2 forbs (lg. Kochia)
	10	45	28	1	75	2	15	23 grass, 5 forbs
16b	1	7	5	<1	40	1	15	3 grass, 2 forbs
	2	12	3	<1	<1	1	35	1 grass, 2 forbs
	3	14	4	<1	20	1	30	2 grass, 2 forbs
	4	21	6	<1	20	2	15	5 grass, 1 forb
	5	23	11	<1	20	<1	10	11 grass
	6	27	5	<1	35	<1	10	5 grass
	7	32	2	1	0	5	25	2 grass
	8	38	0	<1	5	3	10	
	9	43	0	0	2	<1	15	
	10	48	1	<1	0	2	<5	1 grass
17a	1	6	2	<1	3	2	25	2 grass
	2	13	8	<1	7	1	25	7 grass, 1 forb
	3	14	2	<1	25	1	20	1 grass, 1 forb
	4	19	5	<1	0	<1	10	5 grass
	5	20	21	5	5	<1	15	19 grass, 2 forb
	6	28	1	1	15	<1	10	1 grass
	7	35	2	<1	5	1	5	1 grass, 1 forb
	8	38	6	1	0	1	20	6 grass
	9	42	3	<1	45	2	25	2 grass, 1 forb
	10	43	9	1	10	1	20	8 grass, 1 forb
17b	1	7	2	0	7	1	10	2 forb
	2	12	3	<1	25	3	15	1 grass, 1 forb
	3	16	1	<1	5	2	40	1 grass
	4	20	9	2	5	<1	15	8 grass, 1 forb
	5	27	17	3	20	2	15	16 grass, 1 forb
	6	30	2	<1	15	5	15	2 grass
	7	35	13	3	40	2	15	10 grass, 3 forb
	8	39	0	<1	0	2	10	Grazing (rabbit?)
	9	46	8	<1	90	<1	7	7 grass, 1 forb
	10	47	2	<1	5	3	5	2 grass
18a	1	6	1	<1	0	10	5	1 grass
	2	11	3	<1	<1	5	15	2 grass, 1 forb
	3	15	3	<1	0	10	25	3 grass
	4	19	3	<1	0	5	<5	3 grass
	5	27	2	<1	0	2	<5	2 grass
	6	31	3	<1	<1	40	<5	3 grass

Plot #	Frame #	Tape Distance (feet)	Plant stems/ Frame (20x50 cm)	Aerial ----- Cover -----				Comments
				% grass	% forbs	% rock	% Litter	
18a (cont)	7	32	2	<1	<1	7	5	1 grass, 1 forb
	8	39	4	<1	0	5	15	4 grass
	9	46	6	<1	3	2	<5	3 grass, 3 forb
	10	51	6	0	35	5	<5	6 forb
18b	1	5	1	<1	0	7	<5	1 grass
	2	7	8	<1	1	2	5	8 grass
	3	9	3	<1	0	15	10	3 grass
	4	16	0	0	0	10	15	
	5	22	4	<1	0	10	<5	4 grass
	6	28	11	<1	<1	10	25	10 grass, 1 forb
	7	31	1	0	<1	10	10	1 forb
	8	38	10	<1	20	7	15	9 grass, 1 forb; litter primarily woodchips
	9	45	0	0	0	7	15	
	10	49	4	<1	1	3	20	2 grass, 2 forb
19a	1	4	1	<1	20	<1	35	1 grass; kochia
	2	7	6	1	25	<1	15	4 grass, 2 forb
	3	13	4	<1	3	<1	15	4 grass
	4	22	18	5	2	5	25	18 grass
	5	26	7	<1	7	1	10	7 grass
	6	33	10	5	40	1	20	9 grass, 1 forb
	7	39	11	3	30	1	15	9 grass, 2 forb (kochia)
	8	43	1	<1	0	2	15	1 grass
	9	46	1	<1	0	2	10	1 grass
	10	51	14	1	40	2	<5	13 grass, 1 forb (lg. kochia)
19b	1	5	4	<1	5	1	5	3 grass, 1 forb
	2	9	2	<1	0	1	7	2 grass
	3	12	6	1	60	<1	<5	6 grass
	4	15	3	<1	0	1	10	3 grass
	5	20	1	<1	0	2	10	1 grass
	6	25	1	<1	45	<1	15	1 grass
	7	32	1	0	1	1	<5	1 forb (pigweed)
	8	37	0	0	0	2	10	
	9	38	1	2	3	2	10	1 grass
	10	42	0	0	0	2	5	
20a	1	4	7	<1	30	<1	40	4 grass, 3 forb
	2	9	7	<1	30	1	20	4 grass, 3 forb
	3	17	3	<1	15	<1	40	2 grass, 1 forb
	4	21	14	2	15	1	30	14 grass
	5	25	6	<1	0	5	10	6 grass
	6	26	4	<1	7	3	10	4 grass
	7	28	6	<1	3	5	5	6 grass
	8	36	11	<1	5	3	5	10 grass, 1 forb
	9	43	2	<1	0	3	15	2 grass
	10	45	7	1	25	<1	7	4 grass, 3 forb
20b	1	5	1	<1	0	3	5	1 grass
	2	8	0	0	0	1	7	
	3	12	1	<1	<1	1	5	1 grass
	4	19	6	<1	0	2	5	6 grass
	5	27	6	<1	5	1	5	4 grass, 2 forb
	6	30	3	<1	<1	2	7	3 grass

Plot #	Frame #	Tape Distance (feet)	Plant stems/ Frame (20x50 cm)	Aerial Cover -----				Comments
				% grass	% forbs	% rock	% Litter	
20b (cont.)	7	34	0	0	0	5	30	
	8	40	4	<1	0	2	<5	4 grass; fine hairs that appear dead
	9	47	4	<1	3	3	7	4 grass; fine hairs that appear dead
	10	50	5	<1	5	5	10	5 grass; dead

Table B6. Erosion evaluation of Miles City plots, September, 2004.

Plot Number	Erosion score *	Erosion Ranking**	Comments
11	63	Critical	Seeded species very small
12	57	Moderate	Seeded species very small
13	24	Slight	Seeded species very small
14	63	Critical	Seeded species very small
15	25	Slight	Seeded species very small
16A	42	Moderate	Seeded species very small
16B	35	Slight	
17A	37	Slight	Seeded species very small
17B	27	Slight	
18	52	Moderate	Seeded species very small
19A	46	Moderate	Seeded species very small
19B	21	Slight	
20A	51	Moderate	Seeded species very small
20B	52	Moderate	

* Erosion score is determined based on 100 point system developed by Clark (1980)- Erosion Condition Classification System, U.S. Dept. of Interior, BLM Technical Note 346.

**Stable=1-20 points, Slight=21-40 points, Moderate=41-60 points, Critical=61-80 points, Severe=81-100 points.